ProSoft
TECHNOLOGY

Where Automation Connects.

ProLinx®

PWP

ProLinx Gateway

ProSoft Wireless Protocol

2/2/2009

DRIVER MANUAL

Please Read This Notice

Successful application of this module requires a reasonable working knowledge of the ProLinx Module, its connected devices, and the application in which the combination is to be used. For this reason, it is important that those responsible for implementation satisfy themselves that the combination will meet the needs of the application without exposing personnel or equipment to unsafe or inappropriate working conditions.

This manual is provided to assist the user. Every attempt has been made to assure that the information provided is accurate and a true reflection of the product's installation requirements. In order to assure a complete understanding of the operation of the product, the user should read all applicable documentation on the operation of the connected devices.

Under no conditions will ProSoft Technology be responsible or liable for indirect or consequential damages resulting from the use or application of the product.

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Important Installation Instructions

Power, Input and Output (I/O) wiring must be in accordance with Class I, Division 2 wiring methods, Article 501-4 (b) of the National Electrical Code, NFPA 70 for installation in the U.S., or as specified in Section 18-1J2 of the Canadian Electrical Code for installations in Canada, and in accordance with the authority having jurisdiction. The following warnings must be heeded:

A WARNING - EXPLOSION HAZARD - SUBSTITUTION OF COMPONENTS MAY IMPAIR SUITABILITY FOR CLASS I, DIV. 2;

B WARNING - EXPLOSION HAZARD - WHEN IN HAZARDOUS LOCATIONS, TURN OFF POWER BEFORE REPLACING OR WIRING MODULES, and

C WARNING - EXPLOSION HAZARD - DO NOT DISCONNECT EQUIPMENT UNLESS POWER HAS BEEN SWITCHED OFF OR THE AREA IS KNOWN TO BE NONHAZARDOUS.

D "THIS DEVICE SHALL BE POWERED BY CLASS 2 OUTPUTS ONLY.

All ProLinx® Products

WARNING – EXPLOSION HAZARD – DO NOT DISCONNECT EQUIPMENT UNLESS POWER HAS BEEN SWITCHED OFF OR THE AREA IS KNOWN TO BE NON-HAZARDOUS.
AVERTISSEMENT – RISQUE D'EXPLOSION – AVANT DE DÉCONNECTER L'EQUIPMENT, COUPER LE COURANT OU S'ASSURER QUE L'EMPLACEMENT EST DÉSIGNÉ NON DANGEREUX.

Markings

ISA	ISA 12.12.01 Class 1 Div 2
CSA/cUL	C22.2 No. 213-1987

243333

CL I Div 2 GP A, B, C, D
Temp Code T5
II 3 G
Ex nA nL IIC T4 X

0° C <= Ta <= 60° C
II – Equipment intended for above ground use (not for use in mines).
3 – Category 3 equipment, investigated for normal operation only.
G – Equipment protected against explosive gasses.

ProLinx Modules with Ethernet Ports

Series C ProLinx™ modules with Ethernet ports do **NOT** include the HTML Web Server. The HTML Web Server must be ordered as an option. This option requires a factory-installed hardware addition. The HTML Web Server now supports:

- 8 MB file storage for HTML files and associated graphics files (previously limited to 384K)
- 32K maximum HTML page size (previously limited to 16K)

ProLinx Series C (4000); ProLinx Plus (5000); ProLinx Plus with Radio (6000)

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D "THIS DEVICE SHALL BE POWERED BY CLASS 2 OUTPUTS ONLY.

ProLinx Plus with Radio

The following Information and warnings pertaining to the radio module must be heeded:

A "THIS DEVICE CONTAINS A TRANSMITTER MODULE, FCC ID: SDZ-WA-1. PLEASE SEE FCC ID LABEL ON BACK OF DEVICE."

B "THIS DEVICE USES AN INTERNAL COMPACT FLASH RADIO MODULE AS THE PRIMARY RADIO COMPONENT. THE COMPACT FLASH RADIO MODULE DOES NOT HAVE AN FCC ID LABEL. THE COMPACT FLASH RADIO MODULE HAS NO USER SERVICABLE PARTS."

C "THIS DEVICE COMPLIES WITH PART 15 OF THE FCC RULES. OPERATION IS SUBJECT TO THE FOLLOWING TWO CONDITIONS: (1) THIS DEVICE MAY NOT CAUSE HARMFUL INTERFERENCE, AND (2) THIS DEVICE MUST ACCEPT ANY INTERFERENCE RECEIVED, INCLUDING INTERFERENCE THAT MAY CAUSE UNDESIRED OPERATION."

D "THIS DEVICE AND ANY RADIO ACCESSORY SOLD BY PROSOFT MUST BE INSTALLED BY AN AUTHORIZED PROFESSIONAL INDUSTRIAL RADIO SYSTEM INTEGRATOR. FURTHER, ONLY RADIO ACCESSORIES SOLD BY PROSOFT AND SPECIFICALLY TESTED FOR USE WITH THIS DEVICE MAY BE USED WITH THIS DEVICE."

E "THE USER OF THIS EQUIPMENT CANNOT BE WITHIN 20 cm. FROM THE RADIATING ELEMENT DEVICE."

F "CHANGES OR MODIFICATIONS NOT EXPRESSLY APPROVED BY THE PARTY RESPONSIBLE FOR COMPLIANCE COULD VOID THE USER'S AUTHORITY TO OPERATE THE EQUIPMENT."

Industry Canada Requirements:

A "THIS DEVICE HAS BEEN DESIGNED TO OPERATE WITH AN ANTENNA HAVING A MAXIMUM GAIN OF 24 dB. AN ANTENNA HAVING A HIGHER GAIN IS STRICTLY PROHIBITED PER REGULATIONS OF INDUSTRY CANADA. THE REQUIRED ANTENNA IMPEDANCE IS 50 OHMS."

B "TO REDUCE POTENTIAL RADIO INTERFERENCE TO OTHER USERS, THE ANTENNA TYPE AND ITS GAIN SHOULD BE CHOSEN SUCH THAT THE EQUIVALENT ISOTROPICALLY RADIATED POWER (EIRP) IS NOT MORE THAN THAT REQUIRED FOR SUCCESSFUL COMMUNICATION."

C "THE INSTALLER OF THIS RADIO EQUIPMENT MUST INSURE THAT THE ANTENNA IS LOCATED OR POINTED SUCH THAT IT DOES NOT EMIT RF FIELD IN EXCESS OF HEALTH CANADA LIMITS FOR THE GENERAL POPULATION; CONSULT SAFETY CODE 6, OBTAINABLE FROM HEALTH CANADA."

WARNING:

This is a Class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

Your Feedback Please

We always want you to feel that you made the right decision to use our products. If you have suggestions, comments, compliments or complaints about the product, documentation or support, please write or call us.

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2/2/2009

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1   Functional Overview

The ProSoft Wireless Protocol (PWP) driver can be used to interface many different protocols with PWP devices. PWP allows one controller to produce or send an area of its memory onto a network at a specified rate. It also allows another controller to consume or receive this data. Each data message contains a data sample, or snapshot, of a specific portion of the producing node's memory. Data messages are uniquely identified so that consuming nodes can relate the incoming data with a specific configuration (known as an exchange) which describes key characteristics of the data sample. A node can contain a number of these exchanges, so that it may be both a consumer of some exchanges and a producer of others at the same time.

Periodic Data Services provide an efficient mechanism which allows the repeated transmission of a set of variables from a controller which *produces* data, to one or more controllers which *consume* the data. Significant features of the Periodic Data Service include:

- A single request for data from a consumer controller can cause data packets to be sent repetitively from the producer.
- The set of data variables to be sent periodically can be pre-defined so that the controller starts sending the data as soon as it is initialized.
- Data can be sent to the specific node that requested it, or simultaneously to a group of nodes.
- Periodic Data Services utilize a low level protocol (UDP/IP) which requires less overhead than fully acknowledged stream oriented protocols.

1.1   Underlying Protocol Requirements and Constraints

PWP protocol messages are classified as data messages. PWP operates on a message based, connectionless network transport layer, such as the internet UDP/IP protocol. Each protocol message is sent to a specific network access point (UDP port) on one or more destination nodes. Data messages are individually configured to send a sample of data at a fixed periodic rate. Each data message that a node sends or receives is associated with a specific identifier, which uniquely defines the configuration of the data sample. This configuration is called an exchange. PWP allows the configuration of exchanges which are sent to:

- A single destination address (IP Unicast addressing)
- A group of addresses (IP Multicast addressing)
- All PWP nodes (IP Broadcast addressing).

An assigned set of 32 IP Multicast addresses has been defined for use by applications requiring the transmission of data exchanges to a group of nodes. The following tables show the defined network parameters for PWP.

Assigned UDP Network Ports

Parameter	UDP Port
Command Port	7937. (1F01H)
Data Port	18246. (4746H)

Multicast Address Assignments

Parameter	IP Address
Group 1	224.0.7.1
Group 2	224.0.7.2
…	…
Group 32	224.0.7.32

The user defines the data to be produced and consumed in a configuration file downloaded to the module. The driver interfaces with a common internal database in the module. This permits the sharing of data across many different types of networks.

The following illustration shows the functionality of the PWP driver when interfaced with serial communication based and 802.11b wireless networks:
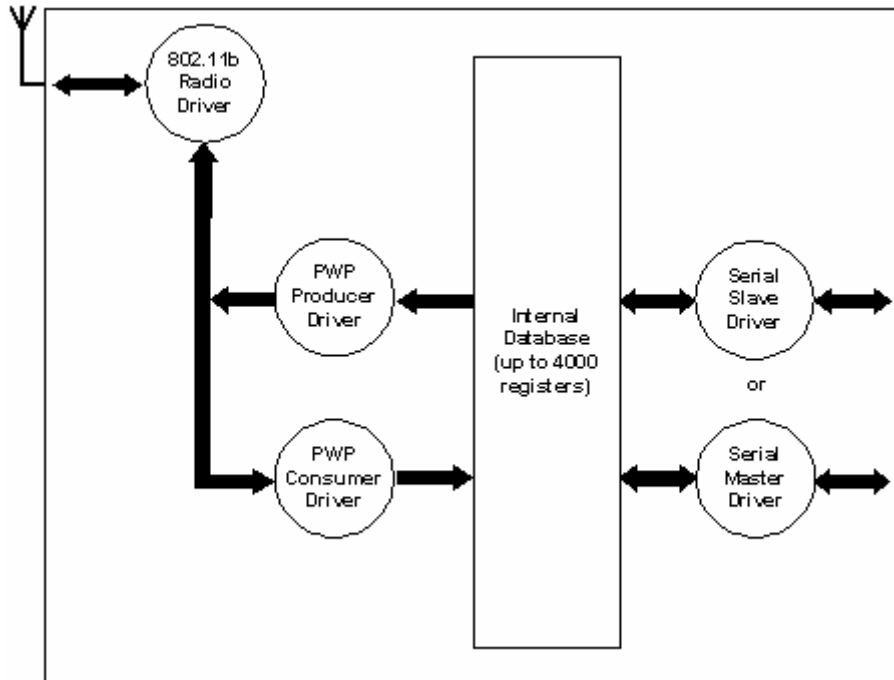
In order to use these functions, an exchange must first exist in the module's exchange list defining the database and register count. If the production/consumption time is set to zero, the exchange will never be produced or consumed and will only be valid for command processing. These functions should be used for data that is not time critical and does not require periodic updating. The maximum length of the message is limited to 1400 bytes.

1.2   Module Internal Database

Central to the functionality of the module is the internal database. This database is shared between all the drivers in the module and is used as a conduit to pass information from one device on one network to one or more devices on another network. This permits data from devices on one communication port to be viewed and controlled by devices on another port. The following topics discuss the relationship of the internal database to the PWP Producer and the PWP Consumer.

1.2.1   PWP Producer

The PWP driver will generate produced data as defined in the user configuration exchange list. This data is derived from the module's internal database and is produced at the set frequency defined in the exchange list. This data can be broadcast to all nodes, sent to a specific multicast group or sent to a specific node on the network. Up to 680 database registers can be transferred in a single produced message. Therefore, to transfer the whole database would only require 6 messages (4000 word registers in the module's database).

The producer functionality provided in the PWP driver is used to transfer portions of the module's database to other PWP nodes on the network. The following diagram describes the flow of data between the Producer, the internal database and the remote Consumer device:
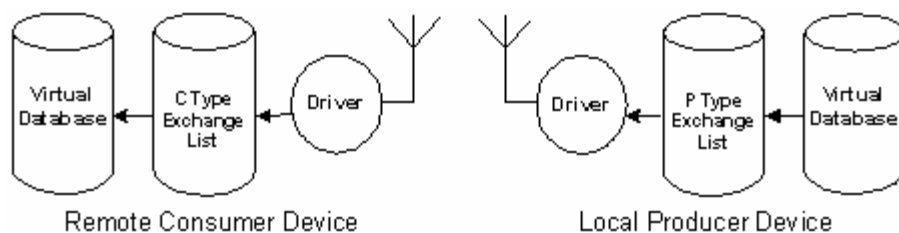
1.2.2 PWP Consumer

The PWP driver will consume data as defined in the user configuration exchange list. This data is derived from other nodes on the network and is placed in the module's internal database. If a consumer exchange is not received at the specified timeout, the driver will update the status of the exchange. When the driver again receives the exchange, the status will be updated. Exchanges received by the consumer driver that are not defined in the exchange list will be discarded. Up to 680 words of data can be consumed in a single message. Therefore, to fill the whole database with values would only require 6 exchanges (4000 word registers in the module's database).

The consumer functionality provided in the PWP driver is used to transfer data from other nodes on the network into the module's database. The following diagram describes the flow of data between the Consumer, the internal database and the remote Producer device:
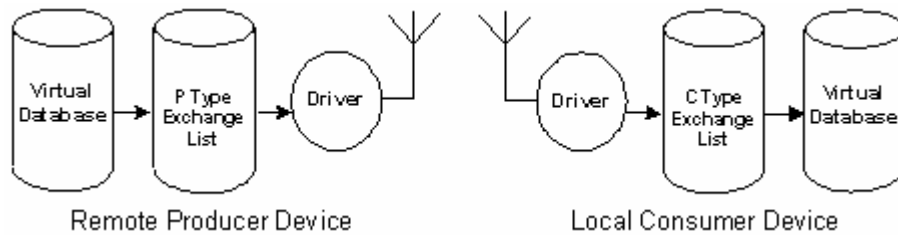
2   Network Configuration and Setup

This section describes the various types of network physical configurations and data transmission configurations.

These modules utilize a full function wireless network card, supporting RF data rates up to 11 Mbps. The modules function as a client, providing an ultra-fast wireless solution for the most demanding industrial applications.

These modules allow you to connect various field devices using different networks or protocols and share data between these devices "over-the-air." This is accomplished by exchanging shared common database information over-the-air with ProSoft Technology's efficient but powerful wireless protocol.

General Radio Specifications

Specification	Value
Frequency	2.4 GHz band (2400 to 2483.5 MHz)*
Wireless medium	DSSS: Direct Sequence Spread Spectrum (802.11 b)
Output power	32 mW (15 dBm)
Channel data rates	11, 5.5, 2, 1 Mbps
Channels: user selectable	11: North America 13: Europe** 14: Japan
Security	PWP + WEP 64/128 Encryption with WEP key rollover management
Antenna Ports	Two RP-SMA connectors, automatic antenna diversity
Bit Error Rate (BER)	Better than 10^{-5}

Range / Transmit Rate	High Speed 11 Mbps	Medium Speed 5.5 Mbps	Standard Speed 2 Mbps	Low Speed 1 Mbps
Open Office Environment	160m (525 ft.)	270 m (885 ft.)	400 m (1300 ft.)	550 m (1750 ft)
Semi-Open Office Environment	50 m (165 ft.)	70 m (230 ft.)	90 m (300 ft.)	115 m (375 ft.)
Closed Office	25 m (80 ft.)	35 m (115 ft.)	40 m (130 ft.)	50 m (165 ft)
Receiver Sensitivity	-83 dBm	-87 dBm	-91 dBm	-94 dBm

* Varies with country regulation
** Some European countries such as France allow fewer channels

2.1.1 Antenna Port (6000 Series Modules)

ProLinx 6000 Series modules provide two RP-SMA connectors, with automatic antenna diversity.

2.2 Basic Service Set

The Basic Service Set defines a group of radios which communicate together within a Basic Service Area. The Basic Service Area is the true physical area which the radio signals travel through. All radios within a single Basic Service Set must be within the same Basic Service Area.

Wireless networks can be configured in two different ways infrastructure and ad hoc modes:

Ad hoc (IBSS) mode allows wireless devices to communicate in peer-to-peer mode with each other. Devices can share information without an AP.

- Faster as it enables direct delivery of network information
- Fast installation and minimal cost.
- More fault tolerant as the application is not dependent on any one peer to function.
- More private as all messages are sent directly rather than through a central server AP.

There are no Access Points in an IBSS. All stations need to be within the range of each other and no integration within existing LAN systems

Infrastructure (BSS) mode allows wireless devices to communicate with a central AP that in turn can communicate with "wired" devices on a LAN.
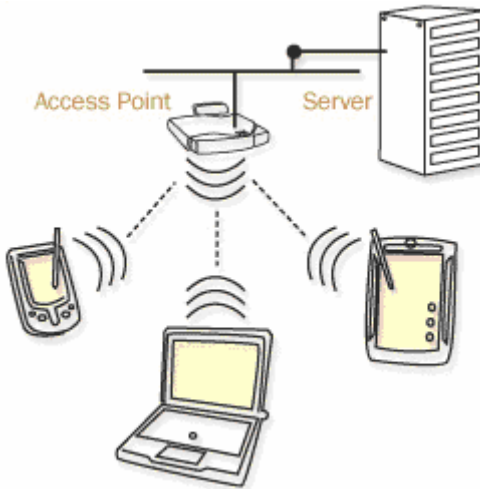
- Achieve longer range by using AP as repeaters
- Deploy more advanced encryption technologies.
- Connect to existing LAN for SCADA operations

2.2.1 Infrastructure Basic Service Set

The Infrastructure Basic Service Set (BSS) requires all radios within the Basic Service Area that wish to communicate on the network to authenticate to and relay through a single Access Point (AP). This AP then relays the message to the appropriate node on the network.

2.2.2 Independent Basic Service Set

The Independent Basic Service Set (IBSS) allows all radios within the Basic Service Area to communicate directly to one another without the need for an AP.

2.3   Connection Control

The module supports two network types:

- Independent (IBSS or ad-hoc)
- Infrastructure

During power up, the module will search for an access point with the same configured SSID. If an access point with same SSID is found, then the module will be connected in Infrastructure mode. Otherwise it will search other modules with the same SSID for IBSS (ad-hoc) connection. The following flow chart explains this simple connection procedure:
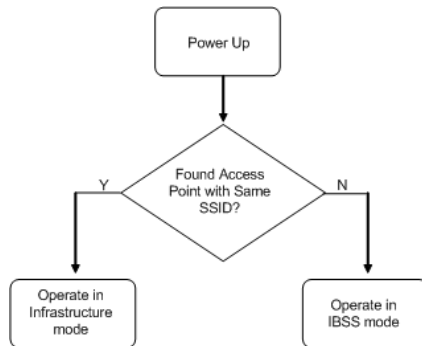
To check the connection mode by referring to the port status using the debug menu by selecting Radio Menu (R) / Status(S). While connected, the port status will indicate either *Connected IBSS* (ad-hoc) or *Connected ESS* (Infrastructure).

The following illustration shows an example where the module is connected in ad-hoc (IBSS) mode.
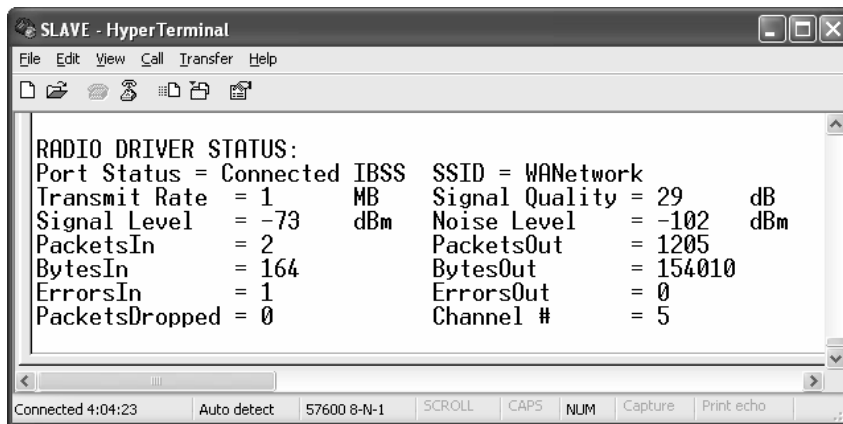
During infrastructure mode, if the module cannot reach the Access Point, it will update the port status to indicate *Out Of Range*. The module will keep trying to connect to an access point with the same SSID. During *Out Of Range* mode the module will not attempt to connect to another module in ad-hoc mode.

The modules also support roaming, meaning that while connected to an access point, the module might choose to reassociate to another access point (with same SSID) depending on the quality signal level.

During ad-hoc mode, if the module loses connection to other modules, the Port Status will periodically switch between *Connected IBSS* and *Searching*. Typically the port status indicates for approximately eight seconds as *Connected IBSS* and for two seconds as *Searching* mode. While displaying *Connected IBSS* mode, the module will keep the last quality signal value recorded before disconnection. The RF Signal LED (indicating last recorded quality signal) and RF Link LED will blink during 8/2 second intervals to indicate that the module is not currently connected and is looking for another module with the same SSID.

Tip: While connected you can check the quality signal level by selecting Radio Menu (R) / *Constant Radio Status Update (1)*. The quality signal level basically reflects the difference between the noise level and signal level.

During power up, the module looks for another module with the same SSID. If it finds another module that has the same SSID but a different channel number, it will switch to that specific channel. However, it is suggested that all modules should be configured for the same channel number. Channels 1 to 14 are available. The following table lists the channels available for some countries:

FCC	channels 1 to 11
ETSI (Europe)	channels 1 to 13
France	channels 1 to 9
Japan	channels 1 to 14

2.4   Backing up Existing Files

Before you begin configuring your module, you should create a backup on your PC of the module's configuration files. Depending on the hardware capabilities of the module, there may be more than one configuration file to copy.

The following procedure describes how to back up these files. Make sure your computer is connected to the module's Configuration/Debug port as shown using a Null Modem cable and ProLinx Adapter Cable.
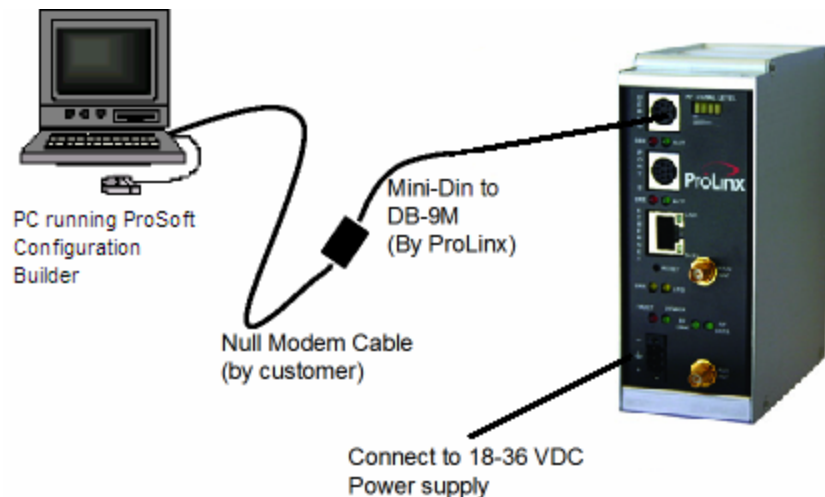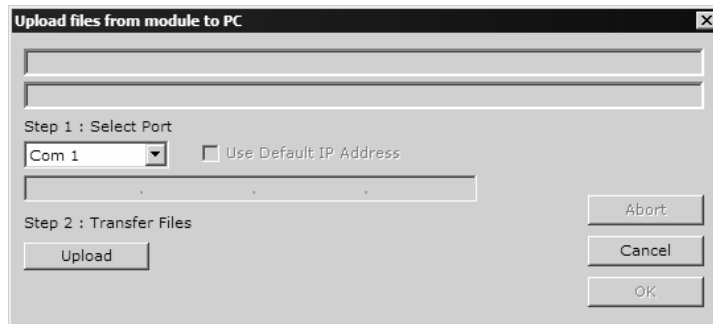
2.4.1 Uploading the Configuration from the Module to Your PC

Perform the following steps to upload the module's configuration file from the module to your PC:

Note: This document uses ProSoft Configuration Builder in all examples.

1 Start ProSoft Configuration Builder on your PC.
2 Select the module, then click the right mouse button to open a shortcut menu.
3 On the shortcut menu, choose Upload. This action opens the Upload Files dialog box.

4 On the Upload Files dialog box, click Upload. ProSoft Configuration Builder will establish a connection to the module and will copy the configuration files from the module into the module configuration in ProSoft Configuration Builder.
5 When the file transfer is complete, click OK.
6 Open the File Menu and choose Save As. Select a folder and filename for your configuration files.

3   PWP Protocol Configuration

In This Chapter

The following is excerpted from a full configuration file showing typical examples of the PWP driver configuration. This example should serve only to give the programmer an idea of how a configuration file is structured. The ProSoft Configuration Builder Software (PCB) will be used to create and download configuration information to the module. PCB and complete configuration files are shipped with each unit and are available on the product CD and from the web site for each of the products. These files can serve as an excellent starting point for any project. Note that the driver only requires configuration of exchanges ([PWP EXCHANGES]) and of the Simple Network Time Protocol ([SNTP CLIENT]) portions of the configuration file.

3.1   [Radio Configuration]

The Radio Configuration section contains basic configuration parameters for the radio. The following settings configure the radio.
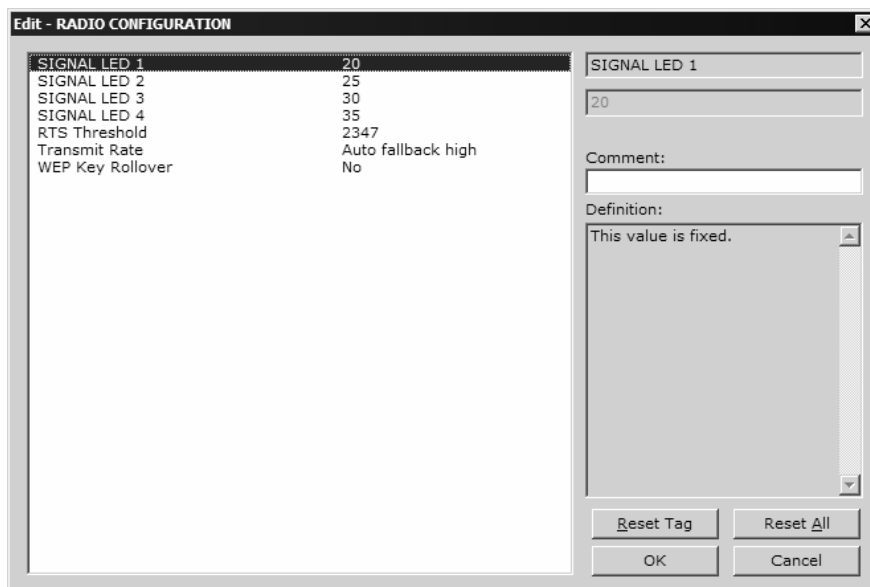
3.1.1 Signal LED 1, 2, 3, 4

SIGNAL LED 1: 20

SIGNAL LED 2: 25

SIGNAL LED 3: 30

SIGNAL LED 4: 35

The Signal LEDs on the front of the module indicate the current quality (signal strength minus noise) of the radio signal. The parameter for each LED determines the signal strength level at which the LED will illuminate.

After the module powers up, all signal LEDs will be off. When the module establishes a connection to another module, the signal LEDs will display the strength of the radio signal.

If the radio communication is dropped when in ad-hoc mode (for example, if the other radio is turned off), the signal strength LEDs will flash periodically at a rate of approximately 10 seconds on and one second off.

3.1.2 Transmit Rate

This parameter defines the data rate(s) for transmission of directed messages. Possible values are outlined in the following table.

Value	Definition
1	Fixed 1 Mbit (1)
2	Fixed 2 Mbit (2)
3	Auto fallback high (11, 5.5, 2, 1)
4	Fixed medium rate (5.5)
5	Fixed high rate (11)
6	Auto fallback standard (2, 1)
7	Auto fallback medium (5.5, 2, 1)

Important: For Multicast mode, use transmit rates of 1 or 2 Mbps for best results.

3.1.3 WEP Key Rollover

Yes or No

WEP (Wireless Encryption Protocol) is an encryption method that allows devices on a wireless network to transmit data securely.

This parameter interacts with the WATTCP parameter "Enable Encryption", and the values for WEP Keys 1 through 4. When the WEP Key Rollover parameter is enabled, the module will randomly change the WEP key.

3.2   [SNTP Client]

The [SNTP CLIENT] section of the **CFG** file is used to specify the parameters for the Simple Network Time Protocol (SNTP) client provided with the protocol driver. This client is required in order to keep the driver's internal clock set correctly. This version of the driver supports the unicast implementation of the SNTP Revision 3 and stratum between 1 and 14.

The module can be configured to periodically synchronize its clock with a remote SNTP server. Approximately every 6 minutes the module sends 10 consecutive requests to the remote SNTP client (at approximately 6 second intervals). You can check these requests and responses by looking at the SNTP Client Configuration Menu (press the N key at the Configuration/Debug Main Menu). If the module receives a valid response from the SNTP server, the computations value will be also be incremented. After 10 consecutive successful requests and responses, the module will synchronize its internal clock (an average is performed based on all 10 responses for better accuracy). The Time Set Cnt value is incremented every time the clock is synchronized.

After the synchronization is performed, the time valid register is set to Yes. If the module cannot connect to the remote SNTP server after 3 consecutive attempts, the time valid register is set to No. You can also configure the GMT settings to use, and the database address where the date and time information can be copied.

The following parameters in the configuration file set up the SNTP client:
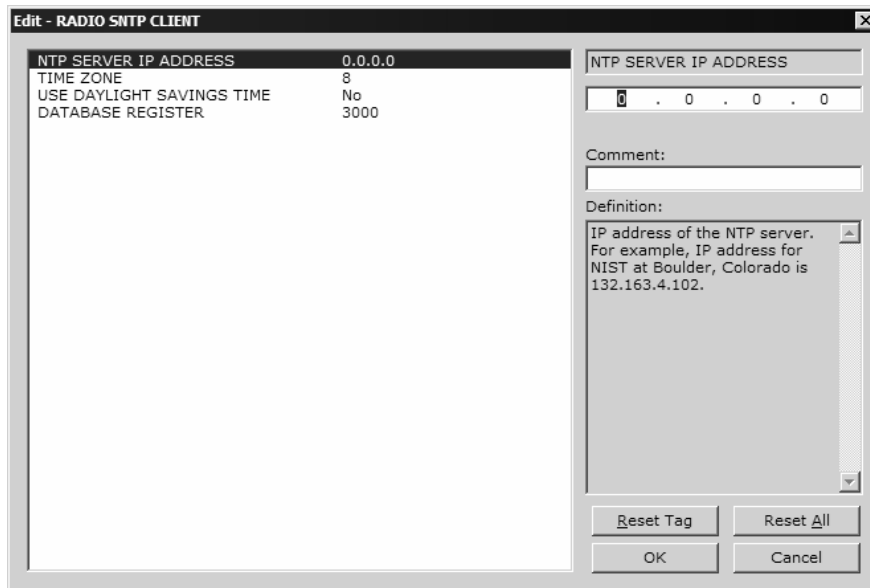
The database register parameter defines a database register where the SNTP time and date values are copied. It occupies 4 words as follows:

Word Offset	Description
0 and 1	Date and time in Unix format (long integer)
2 and 3	Microseconds (long integer)

3.2.1 NTP Server IP Address

Enter in dotted notation

This parameter sets the IP address of the NTP server to contact for time acquisition. Select an NTP server with the greatest accuracy that is available all the time from your network. Set this IP address to 0.0.0.0 to disable SNTP server requests.

3.2.2 Time Zone

-11 to 11

This parameter sets the time zone offset from UTC. Positive values are for time zones west of UTC, and negative values are for time zones east of UTC. Set this value to 0 to use UTC in the module.

3.2.3 Use Daylight Savings Time

Yes or No

This parameter specifies if daylight savings time will be used in the time computation.

3.2.4 Database Register

-1 or 0 to 3992 as an even value

This parameter specifies if the NTP time computed by the driver is to be placed into the module's database. If a value of -1 is specified, the time will not be placed into the database. If the value is between 0 and 3992, the time will be placed in the database. The first 4 bytes represent the seconds since 1/1/1970, and the second 4 bytes represent the number of microseconds. An even value should be used for the register value in order for the data to be stored correctly.

3.3   [RADIO PWP Exchanges]

In order to interface the module with PWP devices, you must construct an exchange list. The exchanges specify messages that will be produced or consumed at a user-defined frequency using the module's internal database. Messages can be broadcast to all nodes on the network, sent to a multicast group on the network or associated with a single node on the network. Up to 100 exchanges can be defined for the driver. Up to 680 word registers can be produced or consumed in a single exchange.

The [RADIO PWP Exchanges] section defines the messages that will be produced and consumed by the driver. The UDP protocol on the IP network is used to transport these over Ethernet between all the PWP devices.

For the exchanges to operate correctly, the other PWP devices must be configured and correctly set up. The primary reason for user problems with the module is failure to provide devices that are correctly configured. Before trying to connect the module to the network, the remote device must be able to communicate with ProSoft Configuration Builder. You must understand and document all parameters.

3.3.1 Exch Type

Producer: exchange will be producing data to other stations

Consumer: exchange will be consuming data from another station

The Exchange Type field defines the type of exchange used in the exchange as either producer or consumer. Producer exchanges (P) are generated by the driver using the module's database. Consumer exchanges (C) are those received from other devices with the data in the message being placed in the module's database.

3.3.2 Cast Type

When the Exchange Type is **Producer,** the cast type field determines if the exchange is a unicast ('U' = point-to-point) exchange, multicast ('M'=multicast group) or a broadcast ('B' = all nodes) exchange.

- Producer Unicast - produce message to another station
- Producer Multicast - produce message to a group of stations. In order to use this option you need to configure the same Multicast IP address used in the exchange also at the [RADIO PWP MULTICAST GROUP LIST] section.

Important: For Multicast mode, use transmit rates (page 18) of 1 or 2 for best results.

- Producer Broadcast - produce message to all stations (set exchange IP address to 255.255.255.255)

When the Exchange Type is **Consumer,** the cast type field determines how the local database area associated to this exchange will be updated in case an RF Error (timeout) occurs.

- Consumer No DB Change on RF Error
- Consumer Set DB to -1 On RF Error
- Consumer Set DB to 0 On RF Error
- Consumer Set DB to 1 On RF Error

3.3.3 DB Reg

The DB Register field defines the starting database register in the module where data sourced (produced data) or placed (consumed data) is determined by the value entered in the DB Reg column. This parameter can have a value of 0 to 3999. The validity of the entry is dependent on the number of registers (Reg Count) to be produced or consumed. The sum of the two values cannot exceed 4000, as this would be outside the range of the module's database.

3.3.4 Reg Count

Number of database registers to transfer/accept in message.

3.3.5 Swap Code

0, 1, 2 or 3

The Swap Code field sets byte and word swapping of data produced or consumed. Swapping of words and/or bytes in the message may be required for different protocol and operating systems as their representation of multi-byte values may not be the same as that of the protocol.

Swap Code	Description
0	None - No Change is made in the byte ordering (1234 = 1234)
1	Words - The words are swapped (1234=3412)
2	Words & Bytes - The words are swapped then the bytes in each word are swapped (1234=4321)
3	Bytes - The bytes in each word are swapped (1234=2143)

3.3.6 P/C Time

The P/C Time field defines the number of milliseconds between productions of the exchange data and for consumed exchanges. This value defines the number of milliseconds to wait for a produced exchanged before a timeout condition is present.

- For a producer exchange it defines the number of milliseconds between consecutive producer exchanges.
- For a consumer exchange it defines the number of milliseconds to wait for a produced message before a timeout error is set. It is suggested to use a value at least four times greater than the value used in the producer exchange.

For consumed messages, set this value to approximately 4 times the produced time of the exchange on the other device. This will prevent the exchange from constantly timing out on a busy network. If this parameter is set to zero, the message will not be produced.

A zero value for a consumed message indicates that the exchange will never timeout. The zero value can be used for exchanges that will interface with the command service port (7937) to handle data read and write requests from another device.

3.3.7 IP Address

The IP Address field should be set to the IP address of destination device (produced data) or source device (consumed data).

Producer Exchange IP address: If the cast type is set to 'U' for a produced exchange, the address should be set to IP address of the specific node to receive (consume) the data. If the cast type is set to 'B' for produced data, set the IP to either a network (255.255.255.255) or subnet (192.168.0.255) broadcast address. If the cast type is set to 'M' for produced data, set the IP address to a valid multicast address.

Multicast Address Assignments

Important: Use Multicast whenever the module produces data to at least two other modules. Using Unicast for these applications can cause data transmission delay when at least one of the consumer modules is powered down.

Multicast group addresses 224.0.7.1 to 224.0.7.32 are reserved. The module does not place this limit for messages but the user should consider using the reserved group addresses. The following table shows the relationship between multicast group parameters and IP addresses. Refer to Underlying Protocol Requirements and Constraints (page 7) for more detailed information on IP and UDP addresses.

Parameter	IP Address
Group 1	224.0.7.1
Group 2	224.0.7.2
…	…
Group 32	224.0.7.32

Important: For Multicast mode, use transmit rates (page 18) of 1 or 2 for best results.

Consumer Exchange IP address: For consumed messages both Broadcast and Multicast type messages should be set to the IP address of the producer generating the specific exchange. The combination of the IP address and the exchange ID uniquely identify the exchange to the system.

3.3.8 Exch ID

1 to 16383

The Exch ID field defines the Exchange ID for this message, and must be unique for each node. For produced exchanges, the module IP address and the entered exchange ID uniquely define the exchange to the network. Defined consumer exchanges use the IP address in the message along with this exchange ID to determine which exchange to associate with the message. The parameters defined in the exchange then determine how much data is present in the message and where to place it into the module's internal database.

3.3.9 CS Major, CS Minor

This is an optional functionality that can be used to prevent unexpected results when changes are performed to existing producer and consumer exchanges.

The Configuration Signature consists of two one-byte integer value (CS Major and CS Minor). The CS Major must be equal for both Producer and Consumer exchanges. The CS Minor reflects backward compatible modifications made to an exchange (for example: adding registers to the producer exchange count). Truncating data within an exchange is not backward compatible and requires a change in the major number.

The purpose of the Configuration Signature (CS) is to guarantee that the produced exchange will contain data in a format expected by a consumer module. Therefore it prevents the consumer module to process received data if it is not compatible because of later modifications.

Whenever a consumer module receives an exchange message, it will look for a configured consumer exchange that contains the same Exchange ID. If it finds a matching consumer exchange it will compare the Configuration Signature for validation.

If the exchange is not validated then the data will not be consumed.

Because this functionality is optional, the modules will exchange data even if the Configuration Signature validation is disabled. To disable this functionality, configure all exchanges with both CS Major and CS Minor values equal to zero.

The following rules are used by the consumer module to validate an exchange based on its Configuration Signature:

Rules for CS Validation

An exchange will be considered valid if at least one of the following conditions is true:

- Producer CS Major and CS Minor are both equal to 0
- Consumer CS Major and CS Minor are both equal to 0
- Producer CS Major is equal than Consumer CS Major AND Producer CS Minor is greater or equal than Consumer CS Minor

The following table contains some examples that will help you to understand the consumer criteria to validate received exchanges based on the Configuration Signature:

Producer CS Major	Producer CS Minor	Consumer CS Major	Consumer CS Minor	Will Data be Consumed?	Comment
0	0	0	0	Yes	Same CS value of 0.0 (Major.Minor) validates the exchange
0	0	1	2	Yes	Producer CS value of 0.0 (Major.Minor) validates the exchange
1	2	0	0	Yes	Consumer CS value of 0.0 (Major.Minor) validates the exchange
1	2	1	2	Yes	Same CS value (1.2) validates the exchange
2	2	1	2	No	CS Major mismatch - exchange is not validated

Producer CS Major	Producer CS Minor	Consumer CS Major	Consumer CS Minor	Will Data be Consumed?	Comment
1	2	2	2	No	CS Major mismatch - exchange is not validated
1	2	1	1	Yes	Same CS Major and Consumer CS Minor is less than Producer CS Minor - exchange is validated
1	2	1	3	No	Same CS Major but Consumer CS Minor is greater than Producer CS Minor - exchange is not validated

3.3.10 Radio PWP Exchange Command List Example

The following is an example section from the [PWP Exchanges] section:
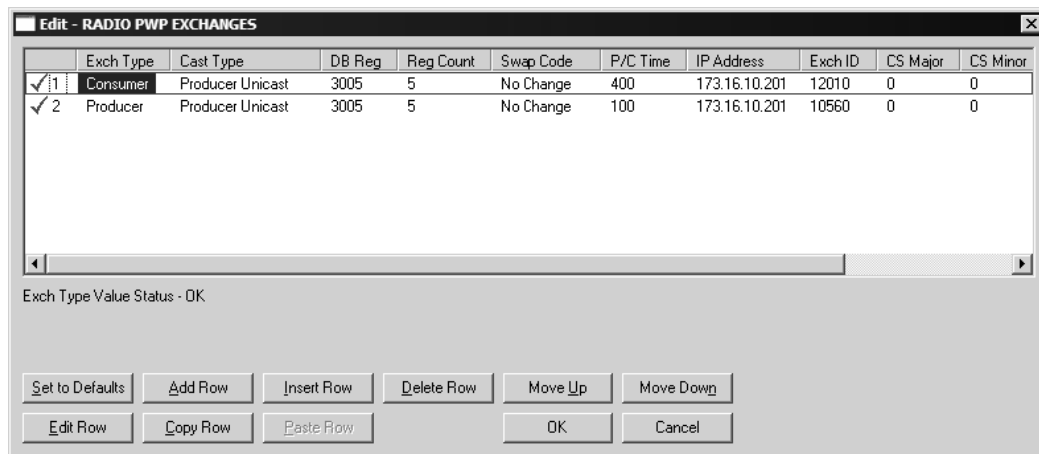
3.4 [Radio PWP Multicast Group List]

This section contains the list of multicast group addresses the PWP server should process (consumer messages for this server produced on other units). This list may contain up to 16 IP addresses. The reserved group addresses for the PWP protocol are 224.0.7.1 to 224.0.7.32. The module will support other group addresses than this data set.

Important: Use Multicast whenever the module produces data to at least two other modules. Using Unicast for these applications can cause data transmission delay when at least one of the consumer modules is powered down.

3.5   Radio Ethernet Configuration (WATTCP)

The Radio Ethernet Configuration is used to configure ethernet and wireless communication information.
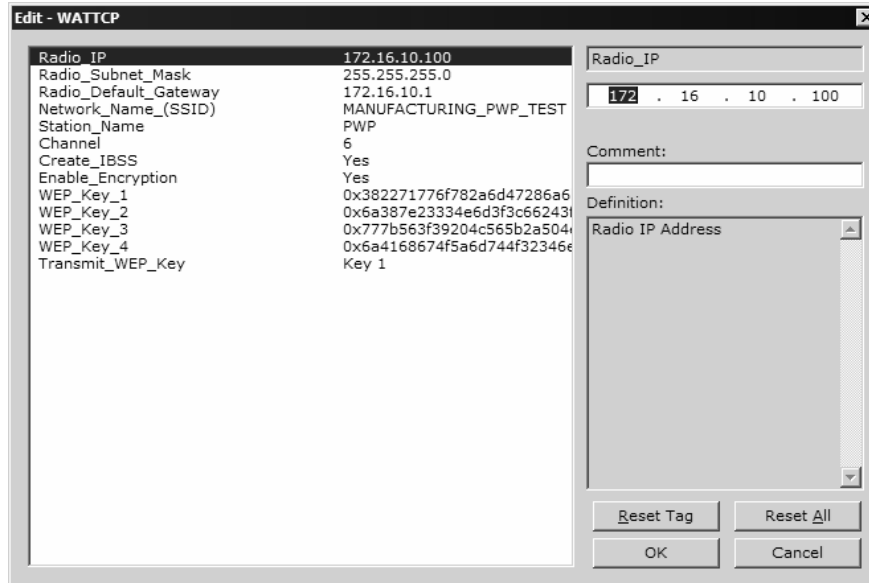
3.5.1   Radio_IP

Default: 192.168.0.100

The IP address of the module to be used in wireless communication.

3.5.2   Radio_Subnet_Mask

Default: 255.255.255.0

The subnet mask to be used in wireless communication.

3.5.3   Radio_Default_Gateway

Default: 172.16.10.1

The default gateway to be used in wireless communication.

3.5.4 Ethernet Settings

> **Important:** The settings for my_ip, netmask, gateway and Local_Domain_Name are only applicable for modules equipped with an Ethernet port. If you are configuring a module without an Ethernet port, you may disregard these settings as they are not used.

my_ip

Default: 192.168.0.100

The IP address for the module. Each word contains one of the four values that comprise the IP address.

netmask

Default: 255.255.255.0

Network mask. Each word contains one of the values for the network mask.

gateway

Default: 192.168.0.1

This is the IP address of the gateway for your network. If you do not supply this, the default is used. So for example if using an IP address of 192.168.0.100 your gateway statement would default to:

gateway=192.168.0.1,192.168.0.0,255.255.255.0

or

gateway=default gateway, default network, default mask

Note: The subnet must be specified for class B subnets

Local_Domain_Name

The local domain name for the module on the wired LAN.

3.5.5 Network_Name_(SSID)

Valid Values: any character in the range of "A to Z", "a to z" and "0 to 9" where:

- The value "ANY" enables your station to connect to any IEEE 802.11 compliant network.
- A "user-defined name" allows your station to connect to a specific network only. This value should match the value as set for the Access Point in your wireless network.

The SSID used when connecting to a wireless network used by an Access Point or Ad hoc station. Value can be alphanumeric string with a maximum of 32 ASCII characters that identifies the network to which you would like to connect your wireless station.

You should configure all modules that will be exchanging data to use the same SSID.

3.5.6 Create_IBSS

The following options are applicable during the module's power-up initialization in its attempt to connect to available devices.

Yes

- **a** Connect Infrastructure (ESS) when Access Point IS available.
- **b** Connect Ad-hoc (IBSS) when Access Point NOT available.

No

- **a** Connect Infrastructure (ESS) when Access Point IS available.
- **b** Will NOT connect Ad-hoc (IBSS) when Access Point NOT available.

3.5.7 Station_Name

An alphanumeric string with a maximum of 32 ASCII characters that will identify your station on the wireless network.

Valid Values: any character in the range of "A to Z", "a to z" and "0 to 9".

3.5.8 Channel

0 to 14 (Default 10)

Channel this module will use on the wireless network. Used for creating Ad hoc link. Channels 1 to 14 are available. FCC allows for channels 1 to 11, ETSI (Europe) channels 1 to 13, France channels 1 to 9, Japan channels 1 to 14. Contact ProSoft Technology for country approval list.

All modules for the same network should use the same channel number.

3.5.9 Enable_Encryption

Y = Yes. Enable WEP encryption

N = No. Do not enable WEP encryption

(Default = N)

Enables or Disables WEP encryption.

When this parameter is enabled, you can:

- Select up to four key for decrypting data received via the wireless interface.
- Select one Transmit key for encrypting data that will be transmitted via the wireless interface.

If you decide to enable encryption, please note that all stations will be configured with identical WEP key values.

3.5.10 WEP_Key_1 to WEP_Key_4

5-character ASCII key or 10-digit hexadecimal key for 64-bit encryption.

13-character ASCII key or 26-digit hexadecimal key for 128-bit encryption.

Identifies one of the four keys your station device can use to decrypt data received via its wireless interface. 64-bit or 128-bit encryption is selected by the number of characters.

The key value is case-sensitive. Hexadecimal values must be preceded by "0x". All wireless clients and access points should be configured with identical key values.

Note: Use only WEP Key 1 when communicating with an RLX-IH access point/repeater.

3.5.11 Transmit_WEP_Key

Selects which WEP key to use for encryption.

Note: If the WEP Key Rollover parameter is enabled, then the module will use a random WEP key out of the four provided, overriding any value specified in this parameter.

4   Diagnostics and Troubleshooting

The module provides information on diagnostics and troubleshooting in the following forms:

- Status data values are transferred from the module to the processor.
- Data contained in the module can be viewed through the Configuration/Debug port attached to a terminal emulator.
- LED status indicators on the front of the module provide information on the module's status.

4.1   The Configuration/Debug Menu

The Configuration and Debug menu for this module is arranged as a tree structure, with the Main Menu at the top of the tree, and one or more sub-menus for each menu command. The first menu you see when you connect to the module is the Main menu.

Because this is a text-based menu system, you enter commands by typing the command letter from your computer keyboard in the diagnostic window in ProSoft Configuration Builder (PCB). The module does not respond to mouse movements or clicks. The command executes as soon as you press the command letter — you do not need to press **[Enter]**. When you type a command letter, a new screen will be displayed in your terminal application.

4.1.1   Required Hardware

You can connect directly from your computer's serial port to the serial port on the module to view configuration information, perform maintenance, and send (upload) or receive (download) configuration files.

ProSoft Technology recommends the following minimum hardware to connect your computer to the module:

- 80486 based processor (Pentium preferred)
- 1 megabyte of memory
- At least one UART hardware-based serial communications port available. USB-based virtual UART systems (USB to serial port adapters) often do not function reliably, especially during binary file transfers, such as when uploading/downloading configuration files or module firmware upgrades.
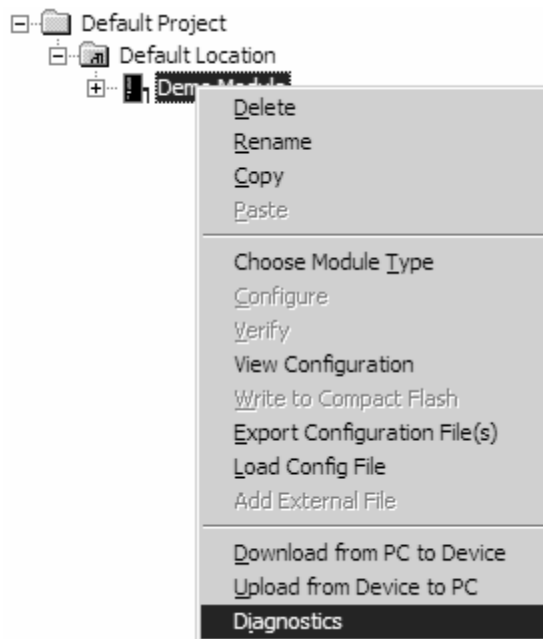- A null modem serial cable.

4.1.2 Using the Diagnostic Window in ProSoft Configuration Builder

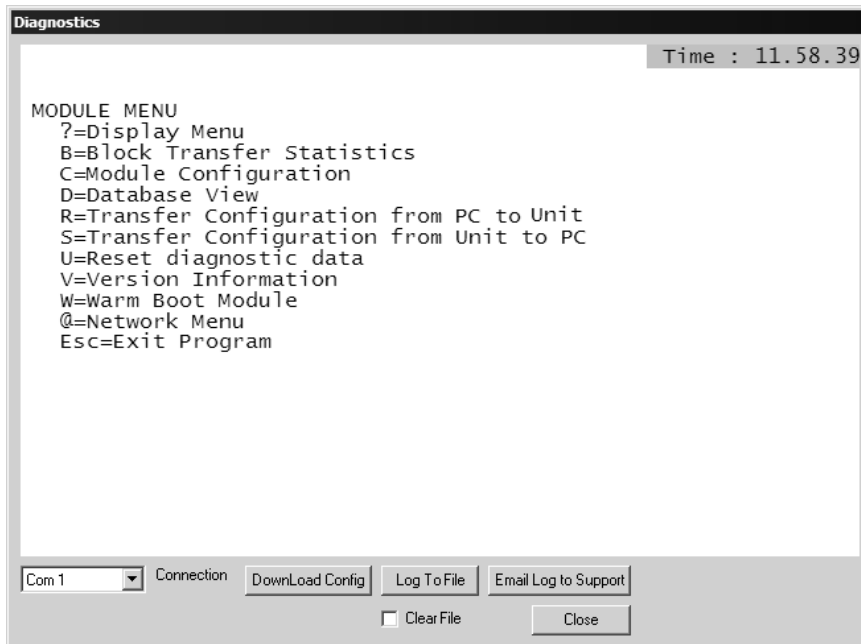To connect to the module's Configuration/Debug serial port:

1 Start PCB program with the application file to be tested. Right click over the module icon.
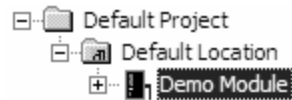
2 On the shortcut menu, choose Diagnostics.

3 This action opens the Diagnostics dialog box. Press "?" to display the Main Menu.

```
Diagnostics

                                              Time : 11.58.39


MODULE MENU
   ?=Display Menu
   B=Block Transfer Statistics
   C=Module Configuration
   D=Database View
   R=Transfer Configuration from PC to Unit
   S=Transfer Configuration from Unit to PC
   U=Reset diagnostic data
   V=Version Information
   W=Warm Boot Module
   @=Network Menu
   Esc=Exit Program




Com 1  ▼  Connection  DownLoad Config   Log To File   Email Log to Support
                                     ☐ Clear File        Close
```

Important: The illustrations of configuration/debug menus in this section are intended as a general guide, and may not exactly match the configuration/debug menus in your own module.

If there is no response from the module, follow these steps:

1 Verify that the null modem cable is connected properly between your computer's serial port and the module. A regular serial cable will not work.
2 On computers with more than one serial port, verify that your communication program is connected to the same port that is connected to the module.

If you are still not able to establish a connection, contact ProSoft Technology for assistance.

4.1.3 Navigation

All of the sub-menus for this module contain commands to redisplay the menu or return to the previous menu. You can always return from a sub-menu to the next higher menu by pressing **[M]** on your keyboard.

The organization of the menu structure is represented in simplified form in the following illustration:

```
                          Main Menu

       Child Menu A       Child Menu B       Child Menu C

       Child Sub-Menu 1   Child Sub-Menu 1   Child Sub-Menu 1
       Child Sub-Menu 2                      Child Sub-Menu 2
       Child Sub-Menu 3
```
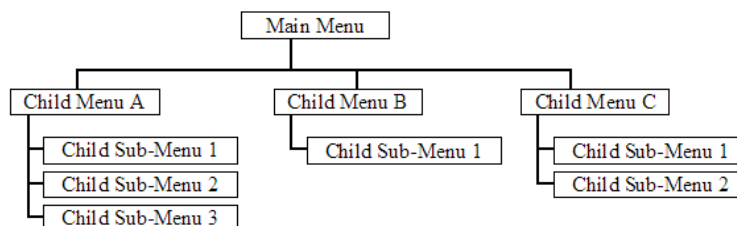
The remainder of this section shows you the menus available for this module, and briefly discusses the commands available to you.

Keystrokes

The keyboard commands on these menus are almost always non-case sensitive. You can enter most commands in lower case or capital letters.

The menus use a few special characters (**[?]**, **[-]**, **[+]**, **[@]**) that must be entered exactly as shown. Some of these characters will require you to use the **[Shift]**, **[Ctrl]** or **[Alt]** keys to enter them correctly. For example, on US English keyboards, enter the **[?]** command as **[Shift][/]**.

Also, take care to distinguish capital letter **[I]** from lower case letter **[l]** (L) and number **[1]**; likewise for capital letter **[O]** and number **[0]**. Although these characters look nearly the same on the screen, they perform different actions on the module.

4.1.4 Main Menu

When you first connect to the module from your computer, your terminal screen will be blank. To activate the main menu, press the **[?]** key on your computer's keyboard. If the module is connected properly, the following menu will appear on your terminal screen:

Caution: Some of the commands available to you from this menu are designed for advanced debugging and system testing only, and can cause the module to stop communicating with the processor or with other devices, resulting in potential data loss or other failures. Only use these commands if you are specifically directed to do so by ProSoft Technology Technical Support staff. Some of these command keys are not listed on the menu, but are active nevertheless. Please be careful when pressing keys so that you do not accidentally execute an unwanted command.

```
WIRELESS COMMUNICATION MODULE MENU
  ?=Display Menu
  B=Profibus Configuration
  C=Module Configuration
  D=Database View
  P=Profibus Menu
  R=Radio Menu
  S=Transfer Configuration from Unit to PC
  U=Reset status
  V=Version Information
  W=Warm Boot Module
  Y=PWP Menu
  Z=SNTP Status
  @=Network Menu
  %=Map Data Menu
  Esc=Exit Program
```

Redisplaying the Menu

Press **[?]** to display the current menu. Use this command when you are looking at a screen of data, and want to view the menu choices available to you.

Viewing Module Configuration

Press **[C]** to view the Module Configuration screen.

Use this command to display the current configuration and statistics for the module.

Opening the Database Menu

Press **[D]** to open the Database View menu. Use this menu command to view the current contents of the module's database.

Opening the Radio Menu

Press **[R]** to open the Radio menu. Use this command to view configuration and status for the module's onboard radio.

Transferring the Configuration File from ProLinx module to PC

Press **[S]** to receive (download) the configuration file from the module to your PC.

Press **[Y]** to confirm the file transfer, and then follow the instructions on the terminal screen to complete the file transfer process.

After the file has been successfully downloaded, you can open and edit the file to change the module's configuration.

Resetting diagnostic data

Press **[U]** to reset the status counters for the client and/or servers in the module.

Viewing Version Information

Press **[V]** to view Version information for the module.

Use this command to view the current version of the software for the module, as well as other important values. You may be asked to provide this information when calling for technical support on the product.

Values at the bottom of the display are important in determining module operation. The Program Scan Counter value is incremented each time a module's program cycle is complete.

Tip: Repeat this command at one-second intervals to determine the frequency of program execution.

Warm Booting the Module

Caution: Some of the commands available to you from this menu are designed for advanced debugging and system testing only, and can cause the module to stop communicating with the processor or with other devices, resulting in potential data loss or other failures. Only use these commands if you are specifically directed to do so by ProSoft Technology Technical Support staff. Some of these command keys are not listed on the menu, but are active nevertheless. Please be careful when pressing keys so that you do not accidentally execute an unwanted command.

Press **[W]** from the Main Menu to warm boot (restart) the module. This command will cause the program to exit and reload, refreshing configuration parameters that must be set on program initialization. Only use this command if you must force the module to re-boot.

Opening the PWP Menu

Press **[Y]** to open the PWP Menu. Use this command to view configuration and status for the PWP protocol.

Viewing SNTP Status

Press **[N]** to view configuration information about the SNTP client.

```
SNTP CLIENT CONFIGURATION:
  NTP SERVER IP : 0.0.0.0
  DB REGISTER   : -1
  TIME ZONE     : 0          USE DST       : No
  TIME VALID    : No
  REQUESTS      : 0          RESPONSES     : 0
  COMPUTATIONS  : 0          TIME SET CNT  : 0
  TIMEOUT ERRS  : 0
```

Refer to SNTP Support for more information on configuring and using this function.

Opening the Network Menu

Press **[@]** to open the network menu. The network menu allows you to send, receive and view the WATTCP.CFG file that contains the IP, gateway and other network specification information. You can find more information about the commands on this menu in the Network Menu (page 40) section.

Opening the Map Data Menu

Press **[%]** to open the Map Data menu. Use this command to view settings and status of the database map.

Exiting the Program

Caution: Some of the commands available to you from this menu are designed for advanced debugging and system testing only, and can cause the module to stop communicating with the processor or with other devices, resulting in potential data loss or other failures. Only use these commands if you are specifically directed to do so by ProSoft Technology Technical Support staff. Some of these command keys are not listed on the menu, but are active nevertheless. Please be careful when pressing keys so that you do not accidentally execute an unwanted command.

Press **[Esc]** to restart the module and force all drivers to be loaded. The module will use the configuration stored in the module's Flash ROM to configure the module.

4.1.5 Database View Menu

Press **[D]** from the Main Menu to open the Database View menu. Use this menu command to view the current contents of the module's database. Press **[?]** to view a list of commands available on this menu.
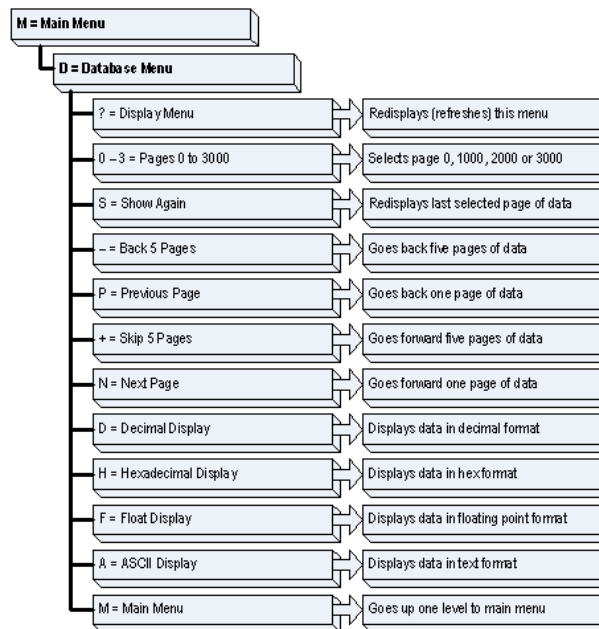
Viewing Register Pages

To view sets of register pages, use the keys described below:

Command	Description
[0]	Display registers 0 to 99
[1]	Display registers 1000 to 1099
[2]	Display registers 2000 to 2099

And so on. The total number of register pages available to view depends on your module's configuration.

Displaying the Current Page of Registers Again

```
DATABASE DISPLAY 0 TO 99 (DECIMAL)
   100    101    102      4      5      6      7      8      9     10
    11     12     13     14     15     16      0      0      0      0
     0      0      0      0      0      0      0      0      0      0
     0      0      0      0      0      0      0      0      0      0
     0      0      0      0      0      0      0      0      0      0
     0      0      0      0      0      0      0      0      0      0
     0      0      0      0      0      0      0      0      0      0
     0      0      0      0      0      0      0      0      0      0
     0      0      0      0      0      0      0      0      0      0
     0      0      0      0      0      0      0      0      0      0
```

This screen displays the current page of 100 registers in the database.

Moving Back Through 5 Pages of Registers

Press **[-]** from the Database View menu to skip back to the previous 500
registers of data.

Viewing the Previous 100 Registers of Data

Press **[P]** from the Database View menu to display the previous 100 registers of
data.

Skipping 500 Registers of Data

Hold down **[Shift]** and press **[=]** to skip forward to the next 500 registers of data.

Viewing the Next 100 Registers of Data

Press **[N]** from the Database View menu to select and display the next 100
registers of data.

Viewing Data in Decimal Format

Press **[D]** to display the data on the current page in decimal format.

Viewing Data in Hexadecimal Format

Press **[H]** to display the data on the current page in hexadecimal format.

Viewing Data in Floating Point Format

Press **[F]** from the Database View menu. Use this command to display the data
on the current page in floating point format. The program assumes that the
values are aligned on even register boundaries. If floating-point values are not
aligned as such, they are not displayed properly.

Viewing Data in ASCII (Text) Format

Press **[A]** to display the data on the current page in ASCII format. This is useful
for regions of the database that contain ASCII data.

Returning to the Main Menu

Press **[M]** to return to the Main Menu.

4.1.6 Radio Menu

Press **[R]** to open the Radio menu. Use this command to view configuration and status for the module's onboard radio.

```
RADIO MENU
C=Configuration
S=Status
1=Constant Radio Status Update
M=Return to Main Menu
```

Viewing Radio Configuration

Press **[C]** to view radio configuration. Use this command to view the port type, channel, data length and other radio configuration settings.

```
 RADIO STATIC CONFIGURATION:
 Port Type    : 1         Own MAC Address: 00:10:C6:47:79:68
 Own Channel  : 10        Own SSID:
 Max Data Len : 1508      Own Name: New
 Encryption   : 0         Authentication  : 1
 TX Rate Ctrl : 3         WEP Key Rollover: No
 LED Levels   : 20 - 25 - 30 - 35
```

Viewing Radio Status

Press **[S]** to view the current operational status of the radio. Use this command to view connection and signal status, packets and bytes transferred, signal quality and errors.

```
 RADIO DRIVER STATUS:
 Port Status = Connected IBSS   SSID = NetworkWA
 Transmit Rate  = 11      MB     Signal Quality = 83       dB
 Signal Level   = -19     dBm    Noise Level    = -102     dBm
 PacketsIn      = 12082          PacketsOut     = 23737
 BytesIn        = 1932496        BytesOut       = 3796798
 ErrorsIn       = 1              ErrorsOut      = 559
 PacketsDropped = 0              Channel #      = 10
```

Continuously Monitoring Radio Status

Press **[1]** to monitor radio status continuously. Use this command to view the signal strength and noise level for the radio in real time.

```
Radio Monitor Enabled.   Press any key to exit.
Q=   48 dB    SL=  -46 dBm    NL=  -94 dBm
Q=   48 dB    SL=  -46 dBm    NL=  -94 dBm
Q=   49 dB    SL=  -46 dBm    NL=  -95 dBm
Q=   50 dB    SL=  -45 dBm    NL=  -95 dBm
Q=   50 dB    SL=  -45 dBm    NL=  -95 dBm
Q=   49 dB    SL=  -46 dBm    NL=  -95 dBm
Q=   49 dB    SL=  -46 dBm    NL=  -95 dBm
Q=   49 dB    SL=  -46 dBm    NL=  -95 dBm
```

Important: When in continuous radio monitor mode, program execution will slow down. Only use this tool during a trouble-shooting session. Before disconnecting from the Config/Debug port, please be sure to press a key to disable the radio status monitor. This action will allow the module to resume its normal operating mode.

Returning to the Main Menu

Press **[M]** to return to the Main Menu.

4.1.7 Network Menu

The network menu allows you to send, receive and view the WATTCP.CFG file that contains the IP and gateway addresses, and other network specification information.
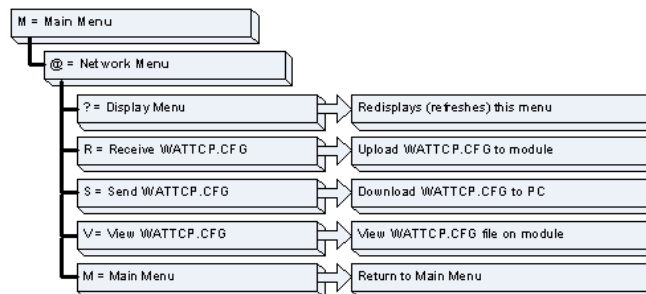
Transferring WATTCP.CFG to the module

Press **[R]** to transfer a new WATTCP.CFG file from the PC to the module. Use this command to change the network configuration for the module (for example, the module's IP address).

Press **[Y]** to confirm the file transfer, and then follow the instructions on the terminal screen to complete the file transfer process.

Transferring WATTCP.CFG to the PC

Press **[S]** to transfer the WATTCP.CFG file from the module to your PC.

Press **[Y]** to confirm the file transfer, and then follow the instructions on the terminal screen to complete the file transfer process.

After the file has been successfully transferred, you can open and edit the file to change the module's network configuration.

Viewing the WATTCP.CFG file on the module

Press **[V]** to view the module's WATTCP.CFG file. Use this command to confirm the module's current network settings.

```
Network Menu Selected

WATTCP.CFG FILE:
# ProLinx Communication Gateways, Inc.
#
# Default private class 3 address
my_ip=192.168.0.135
#
# Default class 3 network mask
netmask=255.255.255.0
#
# The gateway I wish to use
gateway=192.168.0.1
#
#Parameters used by the ProLinx Communication Gateways, Inc. module
#Local_Domain_Name=mycompany.com
Password=PASSWORD
```

Returning to the Main Menu

Press **[M]** to return to the Main Menu.

4.1.8 PWP Menu

Press **[Y]** to open the PWP Menu. Use this command to view configuration and status for the PWP protocol.

```
RADIO PWP MENU
   C=Producer/Consumer List Menu
   G=Multicast Group List
   S=Status Data Menu
   ?=Display Menu
   M=Exit Menu
```

Opening the Producer/Consumer List Menu

Press **[C]** to open the Producer/Consumer List menu. Use this command to view the status of producers and consumers currently communicating on the network.

```
RADIO PWP PRODUCER/CONSUMER LIST 0 TO 9
P/C U/B  ADDR REG_CNT SWP PROD_TIME IP ADDRESS      EX_ID CFG_VER
  P   M   200      32   0       100 224.0.7.1          10   0.0
  C   M     0      32   0       100 224.0.7.1          11   0.0
  P   M   200      32   0       100 224.0.7.2          30   0.0
  C   M    32      32   0       100 224.0.7.2          31   0.0
```

Viewing the Multicast Group List

Press **[G]** to view the Multicast Group List. Use this command to see a list of IP addresses in the radio's configured multicast group.

```
RADIO MULTICAST GROUP LIST (Count=2):
E0000701 224.0.7.1
E0000702 224.0.7.2
```

Opening the Status Data Menu

Press **[S]** to open the Radio PWP Producer/Consumer Status List menu. Use this command to view communication status for each of the configured producers and consumers.

```
Status Data Menu Selected
RADIO PWP PRODUCER/CONSUMER STATUS 0 TO 9
S P MSG_COUNT MISS_COUNT REF_COUNT INVALID TM_SYNC SHORT  LONG PROTO
1 2    14604          0         0       0       0     0     0     0
2 0        0          0    172126       0       0     0     0     0
1 2    14604          0         0       0       0     0     0     0
2 0        0          0    172126       0       0     0     0     0
```

Redisplaying the Menu

Press **[?]** to display the current menu. Use this command when you are looking at a screen of data, and want to view the menu choices available to you.

Returning to the Main Menu

Press **[M]** to return to the Main Menu.

4.1.9 Map Data Menu

Press **[%]** to view the module's error/status data. Refer to PWP Error/Status Data (page 47) for more information on the contents of this screen.

4.1.10 Radio PWP Producer/Consumer List Menu

Press **[S]** to open the Radio PWP Producer/Consumer Status List menu. Use this command to view communication status for each of the configured producers and consumers.

```
RADIO PWP PRODUCER/CONSUMER STATUS MENU
 ?=Display Menu
 S=Show Again
 -=Back 2 Pages
 P-Previous Page
 +=Skip 2 Pages
 N=Next Page
 ?=Display Menu
 M=Return to RADIO PWP Main Menu
```

Redisplaying the Menu

Press **[?]** to display the current menu. Use this command when you are looking at a screen of data, and want to view the menu choices available to you.

Redisplaying the Current Page

Press **[S]** to display the current page of data.

Going Back Two Pages of Data

Press **[-]** from the Database View menu to skip back to the previous 200 registers of data.

Viewing the Previous Page of Data

Press **[P]** to display the previous page of data.

Going Ahead Two Pages of Data

Hold down **[Shift]** and press **[=]** to skip forward to the next 200 registers of data.

Viewing the Next Page of Data

Press **[N]** to display the next page of data.

Returning to the Previous Menu

Press **[M]** to return to the Previous Menu.

4.2   LED Indicators

Troubleshooting the operation of the ports can be performed using several methods.

The first and quickest is to scan the LEDs on the module to determine the existence and possibly the cause of a problem. This section provides insight into the operation of the Serial Port status LEDs. Information on other LEDs can be found in the *ProLinx Reference Guide* or in the product User Manual.

4.2.1 Ethernet LED Indicators

LED	State	Description
Data	Off	No activity on the port.
	Green Flash	The port is either actively transmitting or receiving data.
Link	Off	No connection to hub or network is detected.
	Green Solid	Connected to hub or network correctly. This is the normal operating state.

4.2.2 LEDs for the PWP Port

The following table lists LED status descriptions of the ProSoft Wireless Protocol module.

LED	Status	Indication
ACT (Green)	6 flashes per second.	The PWP is working normally in that it is successfully sending and receiving data. All nodes on the link should be flashing in this pattern.
RF Signal	Blinking in 8 / 2 second intervals	RF signal lost after successful connection.
	One or more LEDs illuminated	RF signal present, number of LEDs illuminated corresponds to signal strength LED values in module configuration file.
	Off	No RF signal detected after power up.
RF LINK	Blinking in 1 second intervals	Not connected.
	Flashing Green	The port is either actively transmitting or receiving data.
	Blinking in 8 / 2 second intervals	RF signal lost after successful connection.
RF DATA	Blinking in 5 second intervals	Not connected.
	Flashing Green	The port is either actively transmitting or receiving data.
	Blinking in 8 / 2 second intervals	RF signal lost after successful connection.

5 Reference

In This Chapter

5.1 Exchange Configuration Form

Use this form to design the exchange list for an application.

1	2	3	4	5	6	7	8	9	10
Exchange Type (C/P)	Cast Type (B/M/U)	Database Address	Register Count	Swap Code	Prod/Cons Time	IP Address	Exchange ID	CFG Signature Version	
								Major	Minor

1	2	3	4	5	6	7	8	9	10
Exchange Type (C/P)	Cast Type (B/M/U)	Database Address	Register Count	Swap Code	Prod/Cons Time	IP Address	Exchange ID	CFG Signature Version	
								Major	Minor

5.2   Radio Status Data

The module's data mapping feature can be used to move Radio Status data into the module's database area. This way the data can be made available to all drivers on the module for use on any of the connected networks.

There is a 14-word register data area for each exchange. The data area is initialized with zeros whenever the module is initialized. This occurs during a cold-start (power-on), reset (reset push-button pressed) or warm-boot operation (commanded or loading of new configuration).

The following table describes each value stored for Radio Status:

Status Register	Status Value	Description
12500 to 12501	Packets in	The total number of MSDUs, with a unicast MAC address as the Destination Address, received successfully.
		+Plus+
		The total number of MSDUs, with a multicast MAC address (including the broadcast MAC address) as the Destination Address, received successfully.
12502 to 12503	Packets out	The total number of MSDUs, of which the Destination Address is a unicast MAC address, transmitted successfully. This implies having received an acknowledgment to all associated MPDUs.
		+Plus+
		The total number of MSDUs, of which the Destination Address is a multicast MAC address (including the broadcast MAC address), transmitted successfully. When operating as a STA in an ESS, and these frames are directed to the AP, this implies having received an acknowledgment to all associated MPG.
12504 to 12505	Bytes in	The total number of octets received successfully as part of unicast MSDUs (PacketsIn). These octets include MAC Header and Frame Body of all associated fragments.
		+Plus+
		The total number of octets received successfully as part of multicast (incl. broadcast) MSDUs (PacketsIn). These octets include MAC Header and Frame Body of all associated fragments.
12506 to 12507	Bytes out	The total number of octets transmitted successfully as part of successfully transmitted unicast MSDUs (PacketsOut). These octets include MAC Header and Frame Body of all associated fragments.
		+Plus+
		The total number of octets transmitted successfully as part of successfully transmitted multicast (incl. broadcast) MSDUs (PacketsOut). These octets include MAC Header and Frame Body of all associated fragments.

Status Register	Status Value	Description
12508 to 12509	Errors in	Number of MPDUs, considered to be destined for this station (Address1 matches), received with an FCS error. Note: This does not include things received with an incorrect CRC in the PLCP header. These are not considered MPDUs.
		+Plus+
		The number of received MPDUs, with the WEP subfield in the Frame Control field set to one, that were discarded because it should not have been encrypted or due to the receiving station not implementing the privacy option.
12510 to 12511	Errors out	Number of times a MSDU is not transmitted successfully because the retry limit (either the ShortRetryLimit or the LongRetryLimit) is reached, due to no acknowledgment or CTS received.
		+Plus+
		The number of transmit requests that were discarded to free up buffer space on the NIC. Transmit queued too long on one of the transmit queues, due to many retries and defers, or otherwise not being able to transmit (e.g. scanning). Transmit queued too long on the Power-Save queue (STA in IBSS: destination STA does not respond to ATIM; AP: STA does not Poll or wake up in time).
		+Plus+
		The number of transmit requests that were discarded because of wrong Source Address (Source Address OwnMACAddress). This only applies to a STA with a BSS Port.
12512 to 12513	Packets dropped	The number of received Message Protocol Data Units that were discarded because of lack of buffer space on the NIC.
12514	Port status	*Connected IBSS* (ad-hoc) or *Connected ESS* (Infrastructure)
12515(1)	LED output	RF Link and Data Values combined (in *MSB)
12515(2)	Signal LED	Value for Signal level LEDs (in MSB)
12516(1)	Link LED	Radio Frequency Link LED indicator. 1 or 0 (in *LSB)
12516(2)	Data LED	Radio Frequency Data LED indicator. 1 or 0 (in MSB)
12517	Length of SSID data (byte count 0 to 32)	Character length of Service Set IDentifier Name.
12518 to 12533	SSID name (32 bytes)	Service Set IDentifier Name.
12534	Tx rate (rounded)	Data Tx rate integer. 11, 6, 2 or 1.
12535	Communication quality	The value of the last recorded quality signal.
12536	Signal level	Received Signal level quality.
12537	Noise level	Received Noise level.
12538	Channel number	Communications Channel.

Status Register	Status Value	Description
12539	Signal LED 1 level	The value from the module configuration file for the signal strength level at which the LED will illuminate.
12540	Signal LED 2 level	The value from the module configuration file for the signal strength level at which the LED will illuminate.
12541	Signal LED 3 level	The value from the module configuration file for the signal strength level at which the LED will illuminate.
12542	Signal LED 4 level	The value from the module configuration file for the signal strength level at which the LED will illuminate.

* MSDU = MAC Service Data Units,
* MPDU = MAC Protocol Data Unit
* LSB = Least Significant Byte
* MSB = Most Significant Byte

5.2.1   PWP Exchange Status Data

Status Register	Description
18000	Exchange message 0 Configuration State
18001	Exchange message 0 Status
18002 to 18003	Exchange message 0 Message count
18004 to 18005	Exchange message 0 Number of times missed
18006 to 18007	Exchange message 0 Number of refresh errors
18008	Exchange message 0 Invalid bit set by producer count
18009	Exchange message 0 Time sync bit set by producer count
18010	Exchange message 0 Short message count
18011	Exchange message 0 Long message count
18012	Exchange message 0 Protocol version number error count
18013	Exchange message 0 Configuration signature error count
18014 to 18027	Exchange message 1 in same format as above for 14 registers
18028 to 18042	Exchange message 2 in same format as above for 14 registers
…	…
19386 to 19399	Exchange message 99 in same format as above for 14 registers

5.3   Radio Networks and Security

802.11 wireless networks operate in one of two modes ad-hoc or infrastructure mode. The IEEE standard defines the ad-hoc mode as Independent Basic Service Set (IBSS), and the infrastructure mode as Basic Service Set (BSS).

In ad hoc mode, each client communicates directly with the other clients within the network, see figure 2. Ad hoc mode is designed so only the clients within transmission range (within the same cell) of each other can communicate. If a client in an ad hoc network wishes to communicate outside of the cell, a member of the cell must perform routing capabilities.
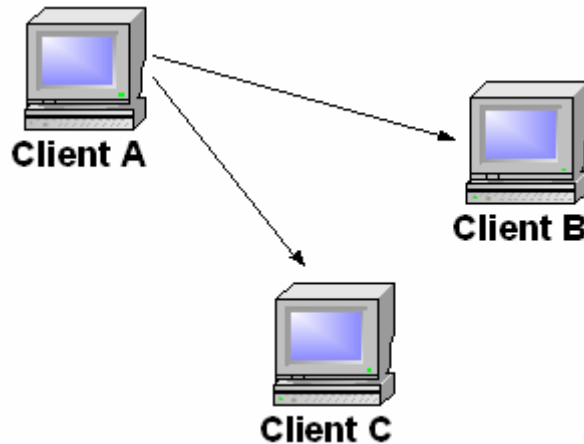
Figure 2: Example ad-hoc network

In infrastructure mode, each client sends all of it's communications to an access point (AP). The access point acts as an Ethernet bridge and forwards the communications onto the appropriate network- either the wired network, or the wireless network, see figure 3.
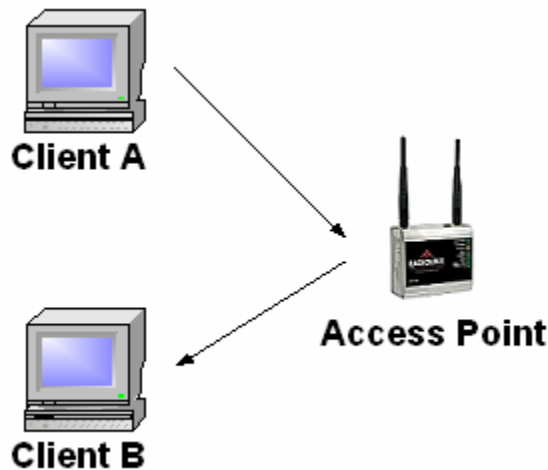
Figure 3: Example infrastructure network

Prior to communicating data, wireless clients and access points must establish a relationship, or an association. Only after an association is established can the two wireless stations exchange data. In infrastructure mode, the clients associate with an access point. The association process is a two step process involving three states:

1 Unauthenticated and unassociated,
2 Authenticated and unassociated, and
3 Authenticated and associated.

To transition between the states, the communicating parties exchange messages called management frames.

We will walk through the process of a wireless client finding and associating with an access point.

1 All access points transmit a beacon management frame at fixed interval. To associate with an access point and join a BSS, a client listens for beacon messages to identify the access points within range. The client then selects the BSS to join in a vendor independent manner.
2 All of the network names (or service set identifiers (SSID)) which are usually contained in the beacon frame are presented to the user so that they may select the network to join.
3 A client may also send a probe request management frame to find an access point affiliated with a desired SSID.
4 After identifying an access point, the client and the access point perform a mutual authentication by exchanging several management frames as part of the process. The two standardized authentication mechanisms are described below.
5 After successful authentication, the client moves into the second state, authenticated and unassociated.
6 Moving from the second state to the third and final state, authenticated and associated, involves the client sending an association request frame, and the access point responding with an association response frame. After following these steps the client becomes a peer on the wireless network, and can transmit data frames on the network.

Open System Authentication

Open system authentication is the default authentication protocol for 802.11. As the name implies, open system authentication authenticates anyone who requests authentication. Essentially, it provides a NULL authentication process. Experimentation has shown that stations do perform a mutual authentication using this method when joining a network, and our experiments show that the authentication management frames are sent in the clear even when WEP is enabled.
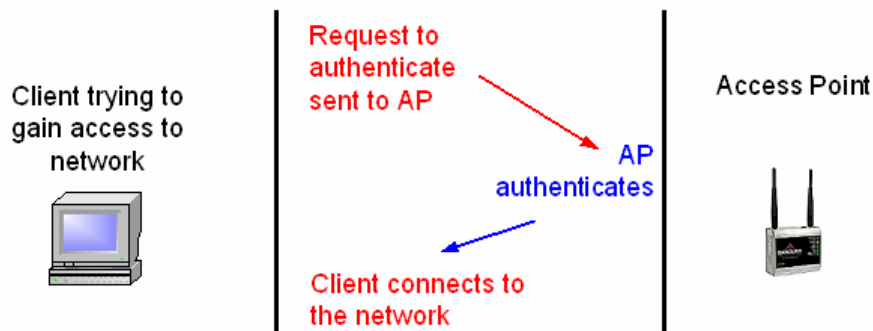
Reference: Your 802.11 Wireless Network has No Clothes - William A. Arbaugh, Narendar Shankar, Y.C. Justin Wan, Department of Computer Science, University of Maryland, College Park, Maryland, 20742, March 30, 2001

5.4 SNTP Status Data

The status data for the SNTP driver is located at the virtual database addresses shown in the following table. The data area is initialized with zeros whenever the module is initialized. This occurs during a cold-start (power-on), reset (reset push-button pressed) or warm-boot operation (commanded or loading of new configuration).

SNTP Client Status	
4030	Time is valid
4031	Request count
4032	Response count
4033	Computation count
4034	Clock set count
4035	Timeout error count

The module's data mapping feature can be utilized to move this data into the module's database area. This way the data can be made available to all drivers on the module for use on any of the connected networks. If it is not mapped into the module's database, the data will only be available through the Configuration/Debug Port.

The Time is valid status register will be set to 1 if the SNTP time is valid. If the time is not valid, the register will be set to 0. All the other registers are counters used to determine the functionality of the driver.

This version of the driver supports SNTP Revision 3 and stratum between 1 and 14.

6   Support, Service & Warranty

ProSoft Technology, Inc. (ProSoft) is committed to providing the most efficient and effective support possible. Before calling, please gather the following information to assist in expediting this process:

1 Product Version Number
2 System architecture
3 Network details

If the issue is hardware related, we will also need information regarding:

1 Module configuration and contents of file
  - o Module Operation
  - o Configuration/Debug status information
  - o LED patterns
2 Information about the processor and user data files as viewed through and LED patterns on the processor.
3 Details about the serial devices interfaced, if any.

6.1   How to Contact Us: Technical Support

Internet	Web Site: http://www.prosoft-technology.com/support
	E-mail address: support@prosoft-technology.com

Asia Pacific

+603.7724.2080, support.asia@prosoft-technology.com
Languages spoken include: Chinese, English

Europe (location in Toulouse, France)

+33 (0) 5.34.36.87.20, support.EMEA@prosoft-technology.com
Languages spoken include: French, English

North America/Latin America (excluding Brasil) (location in California)

+1.661.716.5100, support@prosoft-technology.com
Languages spoken include: English, Spanish
*For technical support calls within the United States, an after-*hours *answering system allows pager access to one of our qualified technical and/or application support engineers at any time to answer your questions.*

Brasil (location in Sao Paulo)

+55-11-5084-5178 , eduardo@prosoft-technology.com
Languages spoken include: Portuguese, English

6.2 Return Material Authorization (RMA) Policies and Conditions

The following RMA Policies and Conditions (collectively, "RMA Policies") apply to any returned Product. These RMA Policies are subject to change by ProSoft without notice. For warranty information, see "Limited Warranty". In the event of any inconsistency between the RMA Policies and the Warranty, the Warranty shall govern.

6.2.1 All Product Returns:

a) In order to return a Product for repair, exchange or otherwise, the Customer must obtain a Returned Material Authorization (RMA) number from ProSoft and comply with ProSoft shipping instructions.

b) In the event that the Customer experiences a problem with the Product for any reason, Customer should contact ProSoft Technical Support at one of the telephone numbers listed above (page 53). A Technical Support Engineer will request that you perform several tests in an attempt to isolate the problem. If after completing these tests, the Product is found to be the source of the problem, we will issue an RMA.

c) All returned Products must be shipped freight prepaid, in the original shipping container or equivalent, to the location specified by ProSoft, and be accompanied by proof of purchase and receipt date. The RMA number is to be prominently marked on the outside of the shipping box. Customer agrees to insure the Product or assume the risk of loss or damage in transit. Products shipped to ProSoft using a shipment method other than that specified by ProSoft or shipped without an RMA number will be returned to the Customer, freight collect. Contact ProSoft Technical Support for further information.

d) A 10% restocking fee applies to all warranty credit returns whereby a Customer has an application change, ordered too many, does not need, etc.

6.2.2 Procedures for Return of Units Under Warranty:

A Technical Support Engineer must approve the return of Product under ProSoft's Warranty:

a) A replacement module will be shipped and invoiced. A purchase order will be required.

b) Credit for a product under warranty will be issued upon receipt of authorized product by ProSoft at designated location referenced on the Return Material Authorization.

6.2.3 Procedures for Return of Units Out of Warranty:

a) Customer sends unit in for evaluation

b) If no defect is found, Customer will be charged the equivalent of $100 USD, plus freight charges, duties and taxes as applicable. A new purchase order will be required.

c) If unit is repaired, charge to Customer will be 30% of current list price (USD) plus freight charges, duties and taxes as applicable. A new purchase order will be required or authorization to use the purchase order submitted for evaluation fee.

The following is a list of non-repairable units:

o 3150 - All
o 3750
o 3600 - All
o 3700
o 3170 - All
o 3250
o 1560 - Can be repaired, only if defect is the power supply
o 1550 - Can be repaired, only if defect is the power supply
o 3350
o 3300
o 1500 - All

6.2.4 Purchasing Warranty Extension:

a) ProSoft's standard warranty period is three (3) years from the date of shipment as detailed in "Limited Warranty (page 55)". The Warranty Period may be extended at the time of equipment purchase for an additional charge, as follows:

• Additional 1 year = 10% of list price
• Additional 2 years = 20% of list price
• Additional 3 years = 30% of list price

6.3   LIMITED WARRANTY

This Limited Warranty ("Warranty") governs all sales of hardware, software and other products (collectively, "Product") manufactured and/or offered for sale by ProSoft, and all related services provided by ProSoft, including maintenance, repair, warranty exchange, and service programs (collectively, "Services"). By purchasing or using the Product or Services, the individual or entity purchasing or using the Product or Services ("Customer") agrees to all of the terms and provisions (collectively, the "Terms") of this Limited Warranty. All sales of software or other intellectual property are, in addition, subject to any license agreement accompanying such software or other intellectual property.

6.3.1 What Is Covered By This Warranty

a) *Warranty On New Products*: ProSoft warrants, to the original purchaser, that the Product that is the subject of the sale will (1) conform to and perform in accordance with published specifications prepared, approved and issued by ProSoft, and (2) will be free from defects in material or workmanship; provided these warranties only cover Product that is sold as new. This Warranty expires three years from the date of shipment (the "Warranty Period"). If the Customer discovers within the Warranty Period a failure of the Product to conform to specifications, or a defect in material or workmanship of the Product, the Customer must promptly notify ProSoft by fax, email or telephone. In no event may that notification be received by ProSoft later than 39 months. Within a reasonable time after notification, ProSoft will correct any failure of the Product to conform to specifications or any defect in material or workmanship of the Product, with either new or used replacement parts. Such repair, including both parts and labor, will be performed at ProSoft's expense. All warranty service will be performed at service centers designated by ProSoft.

b) *Warranty On Services*: Materials and labor performed by ProSoft to repair a verified malfunction or defect are warranteed in the terms specified above for new Product, provided said warranty will be for the period remaining on the original new equipment warranty or, if the original warranty is no longer in effect, for a period of 90 days from the date of repair.

6.3.2 What Is Not Covered By This Warranty

a) ProSoft makes no representation or warranty, expressed or implied, that the operation of software purchased from ProSoft will be uninterrupted or error free or that the functions contained in the software will meet or satisfy the purchaser's intended use or requirements; the Customer assumes complete responsibility for decisions made or actions taken based on information obtained using ProSoft software.

b) This Warranty does not cover the failure of the Product to perform specified functions, or any other non-conformance, defects, losses or damages caused by or attributable to any of the following: (i) shipping; (ii) improper installation or other failure of Customer to adhere to ProSoft's specifications or instructions; (iii) unauthorized repair or maintenance; (iv) attachments, equipment, options, parts, software, or user-created programming (including, but not limited to, programs developed with any IEC 61131-3, "C" or any variant of "C" programming languages) not furnished by ProSoft; (v) use of the Product for purposes other than those for which it was designed; (vi) any other abuse, misapplication, neglect or misuse by the Customer; (vii) accident, improper testing or causes external to the Product such as, but not limited to, exposure to extremes of temperature or humidity, power failure or power surges; or (viii) disasters such as fire, flood, earthquake, wind and lightning.

c) The information in this Agreement is subject to change without notice. ProSoft shall not be liable for technical or editorial errors or omissions made herein; nor for incidental or consequential damages resulting from the furnishing, performance or use of this material. The user guide included with your original product purchase from ProSoft contains information protected by copyright. No part of the guide may be duplicated or reproduced in any form without prior written consent from ProSoft.

6.3.3 Disclaimer Regarding High Risk Activities

Product manufactured or supplied by ProSoft is not fault tolerant and is not designed, manufactured or intended for use in hazardous environments requiring fail-safe performance including and without limitation: the operation of nuclear facilities, aircraft navigation of communication systems, air traffic control, direct life support machines or weapons systems in which the failure of the product could lead directly or indirectly to death, personal injury or severe physical or environmental damage (collectively, "high risk activities"). ProSoft specifically disclaims any express or implied warranty of fitness for high risk activities.

6.3.4 Intellectual Property Indemnity

Buyer shall indemnify and hold harmless ProSoft and its employees from and against all liabilities, losses, claims, costs and expenses (including attorney's fees and expenses) related to any claim, investigation, litigation or proceeding (whether or not ProSoft is a party) which arises or is alleged to arise from Buyer's acts or omissions under these Terms or in any way with respect to the Products. Without limiting the foregoing, Buyer (at its own expense) shall indemnify and hold harmless ProSoft and defend or settle any action brought against such Companies to the extent based on a claim that any Product made to Buyer specifications infringed intellectual property rights of another party. ProSoft makes no warranty that the product is or will be delivered free of any person's claiming of patent, trademark, or similar infringement. The Buyer assumes all risks (including the risk of suit) that the product or any use of the product will infringe existing or subsequently issued patents, trademarks, or copyrights.

a) Any documentation included with Product purchased from ProSoft is protected by copyright and may not be duplicated or reproduced in any form without prior written consent from ProSoft.
b) ProSoft's technical specifications and documentation that are included with the Product are subject to editing and modification without notice.
c) Transfer of title shall not operate to convey to Customer any right to make, or have made, any Product supplied by ProSoft.
d) Customer is granted no right or license to use any software or other intellectual property in any manner or for any purpose not expressly permitted by any license agreement accompanying such software or other intellectual property.

e) Customer agrees that it shall not, and shall not authorize others to, copy software provided by ProSoft (except as expressly permitted in any license agreement accompanying such software); transfer software to a third party separately from the Product; modify, alter, translate, decode, decompile, disassemble, reverse-engineer or otherwise attempt to derive the source code of the software or create derivative works based on the software; export the software or underlying technology in contravention of applicable US and international export laws and regulations; or use the software other than as authorized in connection with use of Product.

f) **Additional Restrictions Relating To Software And Other Intellectual Property**

In addition to compliance with the Terms of this Warranty, Customers purchasing software or other intellectual property shall comply with any license agreement accompanying such software or other intellectual property. Failure to do so may void this Warranty with respect to such software and/or other intellectual property.

6.3.5 Disclaimer of all Other Warranties

The Warranty set forth in What Is Covered By This Warranty (page 56) are in lieu of all other warranties, express or implied, including but not limited to the implied warranties of merchantability and fitness for a particular purpose.

6.3.6 Limitation of Remedies **

In no event will ProSoft or its Dealer be liable for any special, incidental or consequential damages based on breach of warranty, breach of contract, negligence, strict tort or any other legal theory. Damages that ProSoft or its Dealer will not be responsible for included, but are not limited to: Loss of profits; loss of savings or revenue; loss of use of the product or any associated equipment; loss of data; cost of capital; cost of any substitute equipment, facilities, or services; downtime; the claims of third parties including, customers of the Purchaser; and, injury to property.

** Some areas do not allow time limitations on an implied warranty, or allow the exclusion or limitation of incidental or consequential damages. In such areas, the above limitations may not apply. This Warranty gives you specific legal rights, and you may also have other rights which vary from place to place.

6.3.7 Time Limit for Bringing Suit

Any action for breach of warranty must be commenced within 39 months following shipment of the Product.

6.3.8 No Other Warranties

Unless modified in writing and signed by both parties, this Warranty is understood to be the complete and exclusive agreement between the parties, suspending all oral or written prior agreements and all other communications between the parties relating to the subject matter of this Warranty, including statements made by salesperson. No employee of ProSoft or any other party is authorized to make any warranty in addition to those made in this Warranty. The Customer is warned, therefore, to check this Warranty carefully to see that it correctly reflects those terms that are important to the Customer.

6.3.9 Allocation of Risks

This Warranty allocates the risk of product failure between ProSoft and the Customer. This allocation is recognized by both parties and is reflected in the price of the goods. The Customer acknowledges that it has read this Warranty, understands it, and is bound by its Terms.

6.3.10 Controlling Law and Severability

This Warranty shall be governed by and construed in accordance with the laws of the United States and the domestic laws of the State of California, without reference to its conflicts of law provisions. If for any reason a court of competent jurisdiction finds any provisions of this Warranty, or a portion thereof, to be unenforceable, that provision shall be enforced to the maximum extent permissible and the remainder of this Warranty shall remain in full force and effect. Any cause of action with respect to the Product or Services must be instituted in a court of competent jurisdiction in the State of California.

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